the regular parallax program. It is 2'.9 west and 1'.8 south of Boss 1182; the position for 1900 is, therefore:

$$\alpha = 4^h\ 53^m\ 11^s$$
$$\delta = +39^\circ\ 13'$$

The photographic magnitude, derived from counts of stars of equal and brighter magnitude, is 13.2.

This star is the second of the 697 comparison stars, thus far used in the Mount Wilson parallax work, that had to be rejected for comparison purposes on account of large proper motion, the other being the companion of 55 *Cancri*.

A. VAN MAANEN.

THE LIGHT CURVE AND ORBITAL ELEMENTS OF THE ECLIPSING BINARY Y LEONIS

In a recent issue of the *Bulletin Astronomique*[1] Luizet has published results from 498 visual observations of the faint eclipsing binary Y *Leonis*. The estimates of magnitude are carefully made and are well distributed thruout the whole interval of light variation, and when the measures are adjusted to a standard magnitude scale the series of observations affords material for a light curve of more than ordinary completeness and accuracy.

A series of photographic and photovisual observations of the eight comparison stars used by Luizet has been made with the 60-inch reflector. The measurement and reduction of the photographs yields a curve for the transformation of his estimates into photovisual magnitudes, referred to the scale of the Mount Wilson Polar Standards. The range of variation, according to the revised data, is nearly a magnitude greater than that obtained by Luizet from his provisional system of magnitudes.

The adjusted values of Luizet's normal points are plotted for the principal minimum in Figure 1. Each group contains five observations. The theoretical light curve, based on the elements given below, appears in the figure, with open circles representing the computed points. As is frequently the case when the eclipse is deep and total, the orbit and theoretical light curve are very definitely determined. The primary eclipse is almost centrally total; the computed constant phase at minimum is 23 minutes in

[1] Vol. 34, page 169, 1917.

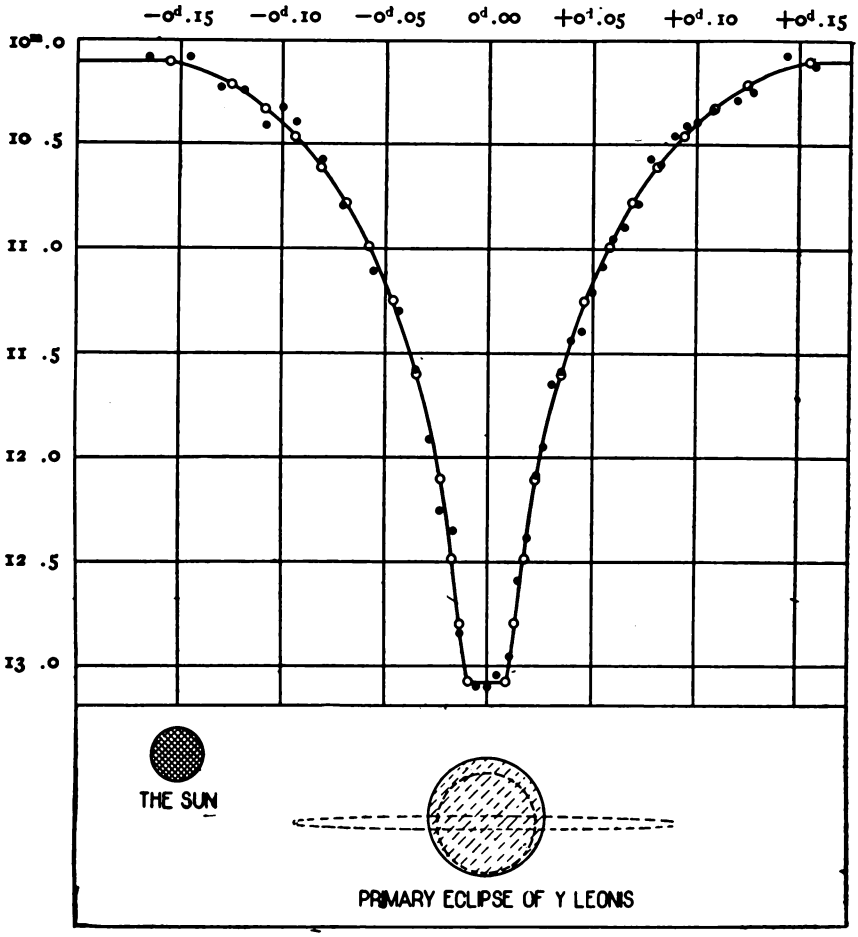

FIG. 1.—The light curve at principal minimum for the eclipsing binary Y Leonis, with a diagram of the system at zero phase.

duration. The secondary eclipse is annular, but is too shallow to be shown definitely by Luizet's observations.

On the assumption of complete darkening at the limb of the brighter component no satisfactory solution appears possible, chiefly because of the absence of a distinct secondary minimum and because of the shape of the primary minimum near zero phase. For darkened stars the upper three-fourths of the observed light curve at primary eclipse would demand equal radii and a central

transit, as may be inferred from the constants in the table of "uniform" elements. This is one of a very few eclipsing systems where the light curve does not permit an equally good (or a better) solution on the assumption of darkening at the limb as for the assumption of uniformly luminous disks. The system shows no other remarkable feature, except, perhaps, the unusually deep eclipse for stars so nearly equal in size. Ordinarily in a system in which the loss of light at primary minimum is several magnitudes, the faint star greatly exceeds the brighter in volume.

ORBITAL ELEMENTS AND OTHER CONSTANTS FOR THE SYSTEM OF Y LEONIS

Right Ascension for 1900	$9^h\ 31^m.1$
Declination for 1900	$+26°\ 41'$
Spectrum	A
Maximum Light	$10^m.11$
Minimum Light	$13^m.08$
Range of Variation at Primary	$2^m.97$
Range of Variation at Secondary (computed)	$0^m.05$
Semi-duration of Eclipse (computed)	$0^d.155$
Nature of Primary Eclipse	Total
Photovisual Magnitude of Brighter Star	10.2
Photovisual Magnitude of Fainter Star	13.1
Ratio of Surface Brightness	20
Hypothetical Parallax of System	$0''.0011$
Absolute Visual Magnitude of Brighter Star	+0.4
Absolute Visual Magnitude of Fainter Star	+3.3
Epoch of Primary Minimum	J. D. 2418054.4243
Period	$1^d.686097$
Inclination of the Orbit	88°.1
Ratio of Radii	0.85
In Terms of the Orbital Radius:	
Least Apparent Distance of Centers	0.033
Radius of Brighter Star	0.251
Radius of Fainter Star	0.295
Hypothetical Radius in Terms of Solar Radius:	
Brighter Star	1.88
Fainter Star	2.21
Relative Orbit	7.48
Density of Brighter Star	$0.23\times\odot$
Density of Fainter Star	$0.04\times\odot$

Both components are absolutely brighter than the Sun, as well as larger. The density of the brighter component is normal for its spectral type. Computation of the most probable density and the hypothetical parallax follows the procedure of former papers.

The period is the value accurately determined by Luizet from observations during an interval of nine years. It has been necessary to add $0^d.002$ to the initial epoch in order to make the zero phase coincide with the middle of the primary eclipse. With this adjustment the minimum appears to be symmetrical within the error of observation.

A provisional orbit of this star, differing considerably in some respects from the present result, has been published by Shapley,[1] on the basis of a rough light curve given by Lehnert.

It is probable that the magnitude effect due to reflection and ellipticity, as well as the secondary minimum, might be shown by a very accurate photometric survey of the maximum light. These quantities must all be very small, however, judging from Luizet's observations of the maximum, and their inclusion in the orbital solution would not be likely to alter the computed orbital data to a very appreciable extent.

MARTHA BETZ SHAPLEY.

UNUSUAL NEBULAR SPECTRA

In the course of work with the nebular spectrograph I occasionally meet nebulae having exceptional spectra. The two nebulae N. G. C. 4449 and 4214 are examples. I found N. G. C. 4449—in 1916, slit over major axis of nebula—to possess a continuous spectrum crossed by the strong emission lines typical of gaseous nebulae. There also appear to be present some absorption lines. The bright lines N_1, N_2, $H\beta$, $\lambda 4686$, $H\gamma$ and $H\delta$ are on the plate; of these N_1, $H\beta$ and $H\gamma$ are the strongest and of about equal strength. N_1 and N_2 are apparently of their normal relative intensity. However, the intensity of the nebulium lines relative to the hydrogen series varies in different parts of the nebula, implying variation in the distribution of these substances. The bright lines may possess other peculiarities: unequal shift or breadth in different parts of the nebula. The nebula is receding from us with a speed of about 200 kilometers. A photograph of this nebula has been published by Pease, *Astroph. Jour.*, July, 1917, Plate IIIb.

The nebula N. G. C. 4214 was shown by Mr. Lampland's plates to have the same general appearance as N. G. C. 4449 just discussed, and we both fully expected its spectrum would prove to resemble that

[1] *Contributions from the Princeton University Observatory*, November 3, 1915.